

Using Treemaps to Visualize Threaded Discussion Forums on PDAs

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ABSTRACT

This paper describes a new way of visualizing threaded discussion forums on compact displays. The technique uses squarified treemaps to render the threads in discussion forums as colored rectangles, thereby using 100% of the limited screen space. We conducted a preliminary user study, which compared the treemap version and a traditional text based tree interface. This showed that the contents of the discussion forum were easily grasped when using a treemap, even though there were in excess of one hundred threads. In particular our technique showed a significant improvement in time for finding the largest and most active threads. Overall, it was shown that the benefits derived from using treemaps on desktop computers are still valid for small screens.

Author Keywords

Treemap, Discussion Forum, Mobile device, Small screens.

ACM Classification Keywords

H.1.2.b Human-centered computing

INTRODUCTION

As the capabilities of mobile devices, such as PDAs, increase, they become more appealing as a substitute for expensive desktop and laptop computers. Designing user interfaces for mobile devices gives rise to different types of challenge as compared to designing for traditional desktop applications; one of the most significant being the reduced screen size.

This project set about exploiting the improved connectivity

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of current mobile devices by allowing PDA users to participate in on-line threaded discussion groups. A threaded discussion forum is a hierarchical data set that may consist of hundreds of threads and sub nodes. Fitting the content on a small screen with the traditional text based tree structure, where nodes are expanded and collapsed, is not ideal. The users will have to scroll horizontally as well as vertically and, moreover, the overview is lost as the number of posts in the forum exceeds the number of text rows that can be displayed on the screen. In 1991, Shneiderman presented the treemap [5], a technique that used the entire display to visualize hierarchical data. The space-filling nature of the treemap makes it particularly useful for PDAs with compact displays, as one is able to exploit as much screen real-estate as possible.

By using a treemap, it is possible to display hundreds of threads on the compact screen without losing the overview. Visualizing many dimensions, such as group activity, with color and thread size with area, potentially improves the browsing process.

VISUALIZING THREADED DISCUSSION FORUMS

To overcome the problems connected with traditional text based browsing schemes, our application uses treemaps to display the contents of the discussion forums. A problem with browsing discussion forums, especially on small screens, is that it is hard to get an overview of the contents. In particular, we wish to provide users with a quick and intuitive overview of the contents and the social activity (such as most popular thread) of the forum. Rather than being a tool for people seeking information on a very specific matter, the main focus is to support browsing behavior, where users are interested in seeing the activity in various groups.

Traditional, text based visualization techniques give the same space to each thread with no regard to attributes that might be interesting to forum users. When browsing a forum socially, some threads are more interesting and treemaps can highlight these threads in a natural way on a small screen by varying attributes such as size and color.

Treemap Layout

In our visualization, the threads are rendered as rectangles in a treemap, with their size being proportional to the number of articles in the thread. The color can be proportional to the activity of the thread or, when searching in the forum, proportional to the relevance of the query for that particular thread.

Representing the posts in the discussion forum as rectangles in the treemap differs, to some extent, from what is normally the case with treemap interfaces. Often [1,5,9], it is the leaf nodes of the tree that are the actual content nodes: files in a directory structure and photos in a folder hierarchy are typical examples. The interior nodes normally work as meta-content placeholders for the actual content. In discussion forums, however, there is no such distinction: the action of creating a new thread is not independent of the first posting to that thread. So, unlike a file system which may have an empty folder, discussion forums have data at both branch and leaf nodes. This means that we cannot do a naïve application of treemaps, but must consider how best to modify them for discussion groups.

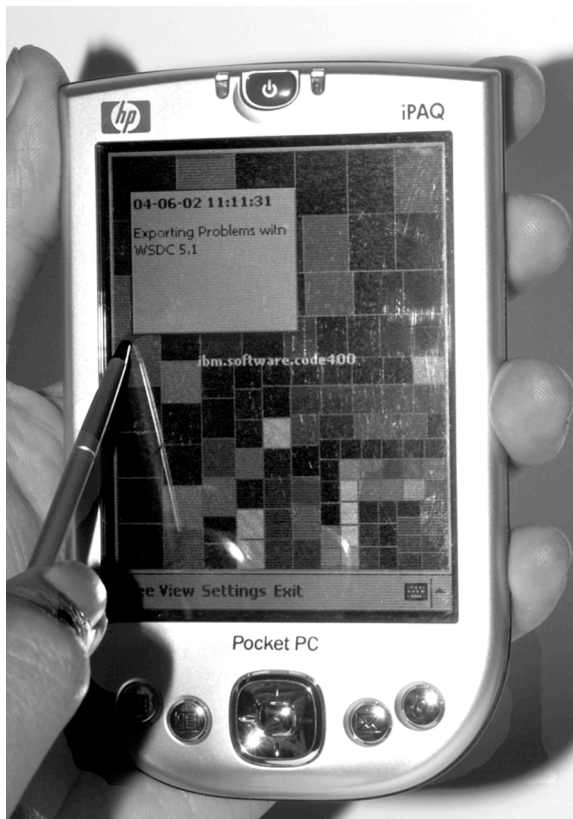


Figure 1 - The image shows the application running on an iPAQ 4150. A close-up is shown in Figure 2 (not the same screen shot)

Since the introduction of the treemap, various layout algorithms have been published (well summarized in [1]), each of which emphasizes different goals. Particularly for compact display treemaps, an aspect ratio close to one is a very important criterion – thin rectangles are hard to select

and their areas are harder to compare. Our system uses the Squarified Treemap Layout [2]. The motivation for using this algorithm is that it produces the best aspect ratios from among the well known algorithms. Additionally, the squarified treemap algorithm has the advantage of placing rectangles with large areas in the upper left corner. This means that the most active threads will now be placed in the position where a user will start reading the screen[4]. Ordering, however, is not preserved. Ordered treemap layouts do exist [7], but due to worse aspect ratios, it was decided to use the squarified layout. The usage pattern that we are interested in, namely browsing the forums for interesting threads and hot topics, does not need ordering in the same way as a normal newsreader would. In news type applications, it would be more important that the articles' positions be consistent across multiple sessions. (A proposal for future work is to implement an ordered treemap layout, and test on users to see which is preferred when browsing.)

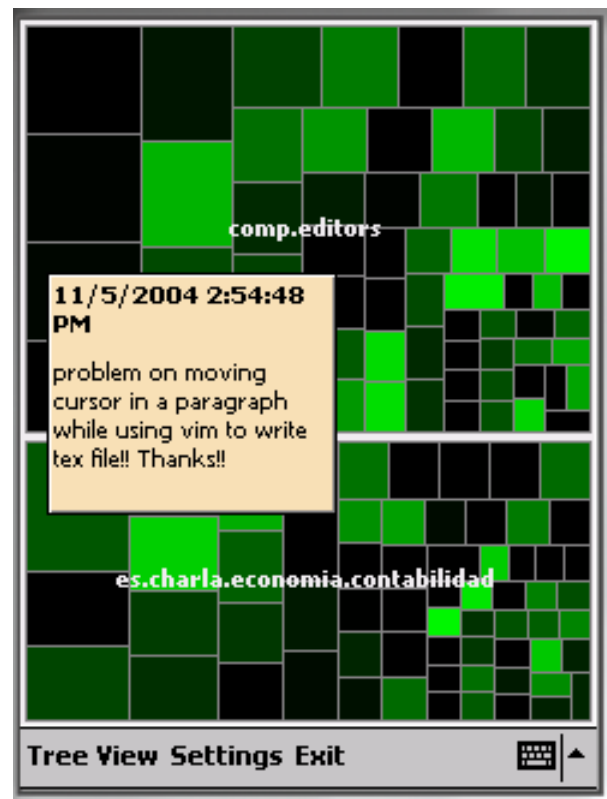


Figure 2 - Visualization of the threads in two discussion forums using the Thread Mode. Size prop. to number of posts in the thread and color prop. to thread activity. The popup, which appears as the stylus is moved across rectangles on the screen, shows date and topic of the threads.

In using a treemap, there is a natural trade-off between overview and detail; the treemap removes detail by replacing text with rectangles, whereas text based interfaces promote detail. In our system, the user is first presented an overview comprised of the top level threads for each forum. This is illustrated in Figure 2, where each rectangle

represents a thread. As the stylus is moved across the rectangles, a popup is shown with date and topic for the particular thread. When the user clicks on a thread rectangle, the content is shown as text.

Introduced in [5], nesting with borders and frames adds an extra cue to show which nodes share the same parent. Our system uses the idea of framing threads to show that they reside in the same forum.

This is obviously not the only way of converting the discussion forum to a treemap. The advantage of this scheme is that it gives a clear overview of the forum, making it easy to compare quantities such as thread activity and size. Several other schemes were implemented, but this approach best displays the attributes that we consider to be key to the application.

RESULTS

The application was implemented in C# & .net Compact Framework targeting Pocket PC 2003. The device used was a Compaq iPAQ 4150 with WLAN.

User Study

The main goal of the study was to evaluate whether treemaps could be used to improve the overview of large discussion forums by highlighting hot topics, which would facilitate social browsing within a forum. The study compared the user's ability to navigate through both a traditional text based tree interface and a graphical treemap. Another goal was to evaluate the suitability of categorizing messages with respect to the thread size and activity within a treemap.

Essential questions such as how the user interprets the graphical information or if the graphical visualisation provided the user with a satisfying overview of the discussion forum, needed to be answered.

Participants

A total of six students, four female and two male, participated in the study. The age ranged from 22 to 30 and three of them had a background in Computer Science. Four had prior experience using PDAs and all were familiar with the notion of discussion forums. However, none of the participants had ever come across treemaps.

The evaluation was comprised of three stages: a conceptual model investigation; a task based analysis and a post-completion semi-structured interview.

Procedure

The conceptual model investigation was used to give us some idea of how intuitively users perceived the visualization. The study began by allowing the participant a few minutes to get familiar with the application. Since every action was recorded, these first few minutes provided significant information on the initial interaction between the participants and the application, for instance: which squares catch the user attention; does the user select color before

size etc. Participants were then explicitly requested to interpret the treemap – without any previous knowledge about the application, users were asked to describe what they thought treemap components represented.

The task based analysis was then used to provide insight into how easily tasks could be completed using treemaps as opposed to a standard, text-based interface. Participants were shown a standard text-based interface and given the following two tasks to complete:

- Find the three largest threads and determine which one of the three is posted most recently.
- Find the three most recently posted threads and determine which of them is largest.

The tasks were chosen as they give useful indications as to whether treemaps could be used for social browsing – large and active threads are important factors when localizing hot topics [4].

Finally, the interview was used as a chance for the users to give us subjective feedback.

Results

The size of the square appeared to draw more attention than color, causing participants to focus on less active big-black squares rather than, say, a smaller, more active green square. While the majority of the participants connected the area to some sort of quantity, color coding did not generate a uniform understanding. Not surprisingly, this outcome is coherent with the fact that people rarely give visual ordering to color [8]. However, when told that color indicated thread activity, the coding proved to be an efficient way of facilitating the treemap navigation. It should be noted that for participants unfamiliar with computers or discussion groups, learning the treemap took longer than learning how to work the text-based interface.

The overall design of the treemap with threads nested inside the forum rectangles was easy to grasp for users. They learned the structure quickly and were able to solve the tasks given them. The only time when the text based interface turned out to be faster, was when the list was sorted directly on the search criterion: e.g. finding the most recent threads is trivial if the list is sorted by date.

Placing important rectangles in the upper left corner is supported both by the user test and in [4]. Therefore, using the squarified treemap layout seems reasonable, as large threads are positioned in the upper left corner. Although this could be achieved with ordered treemaps algorithms too, they produce worse aspect ratios than the squarified layout.

During the user test, it was discovered that users often wanted information on where they are in the forum hierarchy. Therefore, a label showing the name of the discussion forum was added to the treemap. To get the most out of the limited screen space, the name of the forum is

printed on top of the rectangles. An alternative idea would be to print the name in the frame [3], but that was considered to take too much of the valuable screen.

CONCLUSION

The benefits of using treemaps on traditional desktop computers are well known. We wanted to find out whether the advantages of using treemaps instead of traditional text based interfaces are still valid on small screens. Our study confirmed that although reducing the screen size to an area of only 6 % of a desktop screen, the benefits of the treemap is sustained. The user study showed that the concept of using treemaps to visualize discussion forums was intuitive to grasp for people who had limited experience with traditional discussion forums. When compared to a text based interface, searching the forum for largest and most active threads was quicker in the treemap, provided the text version was not sorted on the search criterion. Since thread activity and size are important criteria for social browsing [4], using treemaps is likely to improve the user experience. Overall, using treemaps to visualize discussion forums on compact displays looks highly promising.

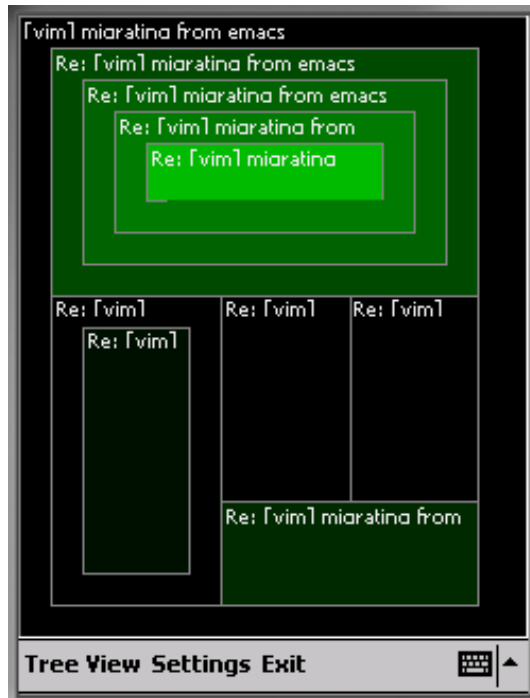


Figure 3 - The articles of a thread are nested inside one another. All articles on a particular level are laid out as a squarified treemap. The child articles are nested inside their parent. Color indicates date.

FUTURE WORK

Different ordered layout algorithms will be implemented and tested to see how this affects the browsing. Worse

aspect ratios are expected, but a potential benefit may be that related articles are positioned adjacently in the treemap.

Further evaluation will be done on displaying all the articles in a discussion forum. One idea that will be tested is nesting the articles inside one another as shown in Figure 3.

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